A SHORT EXPOSITION

OF THE

CIRCULATION AND NERVOUS SYSTEM,

WITH REFERENCE TO

DISEASE AND TREATMENT.

BY

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FORMERLY OF THE MADRAS MEDICAL ESTABLISHMENT.

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PREFACE.

THE muscularity of *tubes* was a subject in which, even as a student, I took great interest,—and early in my medical practice I came to doubt the existence of a muscular power, properly so called, in the arteries; and, consequently, to place no reliance on pathological theories founded on the assumption of an independent power of action in those vessels.

Inflammation, so far from being due to an increased action in the extreme branches of the vascular system, appeared to me to arise from a deficient power of resistance in the capillaries. Ague, I became satisfied, was the result of remora in the venous vessels, and I could see no evidence of the

existence of "spasm" in the extreme arteries,—venous congestion and deficiency of arterial blood accounting sufficiently for the symptoms of the disease.

Such views, of course, influenced my practice, and in no respect more importantly than in the adoption of the *tonic* treatment of erysipelas. I should, however, in all probability, have continued satisfied with privately recommending to my professional brethren, as opportunities might occur, the mode I had found so successful in the treatment of that disease, had not my brother, Dr Charles Bell of this city, who, in early life as my assistant, had learnt duly to appreciate the practice, begged of me two years ago to supply him with a few cases from my journals, for a paper which he was then preparing on the subject for the Edinburgh Medico-Chirurgical Society.

Naturally enough, the announcement of a system of treatment so opposed to established views on the nature of inflammation, —"adding," as one worthy practitioner declared, "fire to fire!"—caused considerable opposition, many condemning the practice

untried; while even those who resorted to my remedy, overlooking the explanation I had suggested of its modus medendi, endeavoured to discover in the effects of the sesquichloride of iron on secretions, the source of its invariable curative effects in erysipelas. It has consequently appeared to me advisable to endeavour to elucidate more fully than I thought necessary on the above occasion, the principle on which my practice is founded; and in order to do so satisfactorily, I have been led to extend my observations beyond the compass I originally contemplated.

In the discussion of the classification I have attempted to establish of the nervous system, there are several points capable of being demonstrated by experiments on living animals; and we owe it to our talented townsman, Professor Simpson, that many of these may now be performed free from their most revolting accompaniment, and with the probability of more effectually elucidating important physiological facts. I must leave this, however, to others, as such enquiries are not compatible with a busy pro-

fessional life, and are peculiarly distasteful to me.

I trust it will not be considered out of place, my taking occasion here to say a few words in favour of a country to which I owe so much as a field for acquiring practical knowledge of disease. In India, diseases are seen as it were through a magnifying glass,—symptoms are not only distinct, but the course of a malady is so rapid, that if art is to avail there must be no time lost in resorting to it. Not only are promptitude and decision required, but in most cases the physician must depend on his own knowledge, as the nearest professional brother may be fifty miles off. This is especially the position of the earlier periods of service.

Indian practice, however, is calculated not only to teach a medical man self-reliance,—an inestimable advantage to the sick,—but from his being under military control, and responsible to his medical superiors for duly keeping journals of cases, and for the regularity of his reports, he acquires habits of the greatest value throughout a professional

career. So highly do I regard the advantages of tropical experience, that I believe some years spent in one or other of the presidencies of India, in charge of a regiment, would prove a better finish to the young physician's education, than to "walk" every hospital in Europe!

There is one lesson of inestimable importance to be learnt in India, to which I must advert,—viz., watchfulness of the progress of disease, and of the effects of remedies. This is often not sufficiently valued in this country by parents in the diseases of infancy, and consequently, the repeated visits of the anxious physician are sometimes received very discouragingly. But the practitioner ought never, from feelings of delicacy, to overlook the importance of watching every stage of infantile maladies, or to forget that life may depend on the loss or gain of an hour.

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CIRCULATION.

The publication of the mode of treating Erysipelas with the muriated tincture of iron, which I had long successfully practised, has happily led to its general adoption in this country, and I have the gratification of finding from numerous communications on the subject, that it has attracted the attention of practitioners in England and on the Continent.

I find, however, that the rationale of the treatment causes considerable difficulty in the minds of many of my friends, and I am informed that there are Teachers, who might be supposed to arrive at correct conclusions on the subject, who throw ridicule on the idea of prescribing a powerful tonic in violent inflammation. I am therefore anxious to bring fully to the knowledge of the profession, the principle on which my practice in this respect is founded. In order to accomplish

this object satisfactorily, it will be necessary that I should enter at some length into the discussion of opinions propounded many years ago in my work on Cholera, which appear to me to deserve more attention, as elucidating Pathology generally, than they have obtained.

The foundation for correct opinions on the subject of Inflammation, is to be laid in an accurate knowledge of the forces and mechanism by which the circulation of the blood is effected.

THE ARTERIAL CIRCULATION.

The great muscular power of the left ventricle of the heart is unquestionably the main source of the current of blood in the Systemic Arteries; in which we may conclude that *vitality* relieves the inner coat from the inconvenience of *attraction;* and that the elasticity of the vessels assists in propelling and regulating the current of blood until it reaches the capillary vessels, where the *per saltum* action ceases; and in which, for functional purposes, nutrition, secretion, &c., the flow of blood requires local control, and is obviously under nervous influence.

Although a full discussion of the much debated question, "the muscularity of Arteries" would exceed the limits assigned to this Essay, still it

is essential to the elueidation of the opinions I entertain, that I should briefly state the views on this subjeet whieh I believe to be eorrect.

The fibrous eoat of the Arteries is that to which museularity is ascribed. It is evident however, that sueh a quality would eonfer on the vessels distributing the arterial blood, independent powers of aetion, and expose the eireulation to the risk of irregularities wholly ineonsistent with its requirements. The term *Tonicity*, whieh the study of the strueture and function of the artery has led modern physiologists to adopt, appears to me to express, without the risk of misapprehension, the resistant and elastie qualities of these vessels. It is entirely dependent on the power of the heart, supplying to that organ all the assistanee museular aetion in the vaseular system eould give, in maintaining and regulating the flow of blood ;—the slight annular yielding affording a modified resistanee to the heart's systolic foree, while the longitudinal stretching threads the blood, as it were, on the retraction of the vessel during the diastolie eessation of the Vis a tergo, rendering the flow of the blood continuous.

When the blood reaehes the eapillary terminations of the Arteries, the *per saltum* eharaeter of its current eeases, and it would appear that

the *elastic* property at least, of tonicity does not extend to the minute arterial branches.

The "Capillary power," as it is denominated, viz., the means by which the Capillary vessels influence the blood flowing through them, is a subject of peculiar interest to the Pathologist. Unlike the elasticity of the arteries, it is not dependent on the action of the heart, but is one of those properties which, in lieu of a better term, are called vital. The Capillaries do not pulsate, and without appreciable alteration in their calibre are enabled to accelerate, retard, or even to suspend the current of the fluid they circulate. In their normal state therefore, they must be capable of resisting the interference of the Cardiac force; and when they no longer possess this power, they are injected with red blood,—and inflammation, attended with pulsation, heat, &c., is established.

THE VENOUS CIRCULATION.

The transmission and distribution of the blood by the arteries is however but one half of "the circulation;" the return of the blood to the heart being an equally important portion of the function; although not so easily explained.

The nourishment of the body, and the necessities of the various secretions, having thoroughly

deprived the blood of its vital properties, it is loaded, principally by the absorbing powers of the veins, with the effete material of animal substances in the incipient stage of decomposition, to be conveyed to the great Emunctory organs by which those impurities are thrown off.

The veins usually originate in the arterial Capillaries, but not invariably, as they are sometimes, like the absorbent vessels, filled from the tissue, without an immediate connection with the extreme branches of the arterial system. From the nature of the capillary circulation, it is evident that vessels filled by them, or by the absorption of fluids suffused in the tissue of the frame, cannot have much assistance from the heart or arteries in propelling their contents; but even were the Vis a tergo more powerful than there is reason to believe, at the commencement of the veins, its force would soon be weakened from the altered arrangement of the vessels, as the blood now passes not only from branches to trunks, but spreads out, as it were, into an area three times greater than that of the arteries.

Coats similar to those of the arteries are assigned to the veins, and their fibrous coat is talked of as if it assisted the current of blood;—they no doubt possess a certain degree of elasticity, as is proved by the jet of blood in venesection, but it is

clear that without pulsation this quality can serve little purpose in propelling the blood; and it is only necessary to refer to varicose veins, to be convinced that the elasticity of these vessels possesses none of the character of the tonicity of the arteries.

The muscular actions of the body are also believed to assist in the onward movement of the blood in the veins: besides the irregularity of such aid to this important function, there is reason I think to believe, that muscular exertions, by compressing the deeper seated vessels, are calculated to retard rather than to advance the circulation of the veins;—undoubtedly the valves are most in request under bodily exercise.

The difficulty of explaining satisfactorily the passage of the blood in the veins by any of the means I have adverted to, has led Physiologists to ascribe to mechanical laws, the agency effecting this great office. Thus the blood is supposed to be drawn from the extreme periphery mainly by the suction of the heart, or of the chest. Without adverting to the extent and complication of the vessels over which this power of suction must be exerted, it is sufficient to observe that suction would act on the walls, and not on the contained fluid of *flexile* tubes.

Again, the hydrostatic law by which enclosed

fluids rise to their level of departure, has been assumed as the mode adopted for returning the blood to the heart. The inevitable risks which would accrue to the system from the regulation of this great function being dependent on a mechanical law, certain to act so differently in the upright, and in the recumbent positions of the body, is so evident, that there is reason to believe, that the controlling agent of the venous circulation is enabled to counteract, rather than to yield to such influence.

It is however, more easy to prove that others have failed to account for the continuous flow of blood in the veins, than to determine what is really its source, and I am quite aware that I make no great step in elucidating the point, by ascribing this important function, mainly to the agency of a principle of which we know nothing but by its effects; such however is the result of all attempts to account for living phenomena; we must at last reach the fons ignotus, and I am quite aware that I have arrived at this point when I attribute the movement of blood in the veins to the principle of *vitality*. We know however, that in the living sponge the current of water is continuous without apparent muscular cause;—that the vegetable kingdom possesses the power of regulating the ascent of the sap ;—that " a remarkable pro-

vision exists in many animals belonging to the inferior tribes, by which fluids are moved along the surface of different organs;"* and, that in the highest organisation the capillary vessels control their contents. In contending, therefore, that the venous circulation is in a great degree under the influence of *vitality*, it is only extending to that portion of the vascular system, the influence of a power which is admitted to pertain to those vessels in which the veins originate.

Before concluding this portion of my subject, it is necessary that I should say a few words on the Portal system of veins. In this department of the venal system, an influence beyond a weak vis a tergo appears quite indispensable; for not only are there no valves to interfere with the current of blood in either direction, but there exists a separate compartment, in which a circulation takes place differing very little from that of the chest. The functional circulation of the lungs is an appendage as it were, of the systemic circulation, but the flow of blood in its arteries is effected by the side of the heart appropriated to it; while the veins which convey the purified blood to the arterial heart, being similar

* Sharpey.

in structure to the systemic veins, are we may conclude under the same vital influence. But while the portal system is also an offshoot from the systemic circulation, it is under very different circumstances from the pulmonary. The vena portœ, like the pulmonary artery, has to distribute blood to a great glandular apparatus, little inferior indeed in bulk to the lungs. It effects this without muscular aid, and thus affords evidence of the power I have ascribed to vitality. This is a subdivision of the venous systems, strictly appropriated to the alimentary canal, and to the glands ministering to its functions—and its importance with reference to disease and treatment, will render a fuller discussion of its peculiarities necessary in a future portion of this essay.

The attempt thus made to explain the circulation of the blood, would be incomplete and unsatisfactory if unaccompanied by an exposition of the views I entertain on the nervous system; and of the distinctions in its economy, which I believe to be the true foundation for correct Nosology; and for the principles on which the doctrines of therapeutics should be based.

THE NERVOUS SYSTEM WITH REFERENCE TO PATHOLOGY AND THERAPEUTICS.

Although the nervous system in man, as a whole, is under the influence of the brain, which, no doubt by nerves appropriated to the purpose, is enabled to harmonize the whole complicated economy of the frame, still the characteristics of the progressive development, from the inferior to the more perfect structure, seem to be retained, in so far that there are distinct classes of nerves acting on different departments of the system—each liable to be influenced by diseases, accidents, or medicinal agents, which do not act directly on the other classes of nerves.

Following out these views, I find four divisions of nerves, viz.:—the Sensorial; the Respiratory; the Motor-Organic; and the Sympathetic, or Secerning Organic.

1. The Sensorial class of nerves—includes the senses, the nerves of sensation, and those controlling voluntary motions.

2. The Respiratory nerves are those by which breathing is maintained as an *involuntary* function.

3. The Organic motor nerves are those which act on the *organic* muscles.

4. The Sympathetic,—or Secerning Organic system of nerves—acting on non-muscular vessels, is the principle agent in effecting Digestion, Assimilation, Secretion, Nutrition, and Excretion.

In endeavouring to establish the correctness of the above classification of the nerves, I shall make no attempt to treat the subject anatomically; nor, except incidentally, to determine the sources of the different nervous systems. But, by reference to disease, experiments, and the effects of medicinal substances, I trust I shall be enabled to demonstrate the distinctions I believe to exist, and to prove their important bearings on pathology and therapeutics.

In what follows I shall freely make use of the physiological experiments of others,—which, indeed, I consider greatly more valuable than any by which I might attempt to prove the correctness of my views, as such would have been liable to the suspicion of a bias. My opinions originated in the study of disease in India, and my first notes on the subject were written when I was detached from head-quarters to a native court in the jungle (The Tondiman's),* to

* The capital of The Tondiman is situated in the centre of a thick jungle, which in former years was almost impenetrable, and an effectual defence from enemies.

treat an intermittent fever, which had carried off, in the cold stage, the chief and many of his principal servants; and where I had not a medical book to refer to, and when as yet I was unacquainted with Sir B. Brodie's invaluable experiments with poisons.

1. *The Sensorial Nervous System.*—In sanguineous apoplexy, when the injury is limited to the source of the sensorial nervous energy, sensation and volition are suspended. Breathing, however, goes on regularly, and the pulse, although slow, is strong and regular, while the nutritive and secreting functions continue to be performed. The patient is as if in a deep sleep. In such a case of apoplexy, the conclusion is, that there is congestion in a portion of the brain,—and according to the unembarrassed state of the respiration, so is the prognosis favourable.

The suspension, however, of this department of nervous energy takes place without vascular turgescence.

Quiet and refreshing sleep, is, I conclude, unattended by a congested state of the vessels of the brain,—and probably, when sleep is lethargic and unrefreshing, there is a loaded state of the venous circulation in the head.

The inhalation of chloroform, in a normal state

of the respiratory function, viewed as an experiment, is a complete demonstration of the extent of the sensorial nervous department. When the system, by the inhalation of this invaluable anæsthetic agent, is brought thoroughly under its influence, the respiration, the circulation, the muscular actions of the bowels, the uterine action, remain wholly unaffected, while the nervous communication with the brain is so completely suspended, that what would otherwise occasion the greatest agony, produces no sensation,—and a patient will awake from this state of insensibility, however long it may have been maintained, without a symptom tending to the belief that there had been cerebral congestion.

Nervous apoplexy, if limited to the sensorial system, which I suspect it seldom is, seems to act like a severe concussion of the brain, in which the shock is so great as to extend to the *controlling* influence of that organ over the nervous system generally, thence the heart's action is affected, becoming weak and irregular. The circulation consequently fails, and the evil of course is increased, from a deficiency in the supply of blood required by the brain. I refer to this mainly to prove the diagnostic advantages of the classification I am endeavouring to illustrate,—and there are few occasions in which a correct and *imme-*

diate diagnosis is of more importance than when the question is between sanguineous and nervous apoplexy.

2. *The Involuntary Nerves of Respiration.*—In treating of this class of nerves, and limiting it strictly to that portion of the system which maintains respiration as an involuntary function, it would be out of place to enter on that extensive and interesting field of enquiry so successfully cultivated by the late Sir Charles Bell,—viz., the union of nerves, voluntary and involuntary, in the mental operations, to the expression of which respiration is an agent;—the chest, as being in this respect the organ of the mind, having of course its muscular mechanism under the control of the sensorial nervous system. But respiration, as the function on which the continuance of life depends, requires a nervous department wholly distinct from those nerves over which the mind has control.

Sleep, disease, poisons, mechanical injury, and medicinal agents, will suspend the sensorial nervous energy, without interrupting respiration. Involuntary breathing, on the other hand, may cease, while as yet the sensorial nerves maintain their full powers.

There is a case related by Sir C. Bell, in

his work on the nerves, which affords a good illustration of the actions of the voluntary and involuntary nerves in respiration. The patient was a medical man, who ascribed his condition to a malignant West Indian fever. Sir C. Bell says of this patient :—" On falling asleep just at the moment when volition and sensibility cease, the involuntary motions stop with a sensation of death, under which he awakes generally convulsed." He adds : " The case presents to us a lively idea of what would result were the involuntary nerves subjected to the same law with the nerves of sense and volition, for then sleep would be death!"*

There can be no doubt of the correctness of this observation, and were such a case treated with chloroform, in the hope of giving quiet sleep, its truth would be established. I have no doubt that in the above case, the injury resulting from the malignant fever, had been to the *source* of the involuntary respiratory nerves.

Asthma, when unconnected with organic disease of the heart or lungs, is, it appears to me, a state of suspension of the energy of the involuntary nerves of breathing. When a paroxysm of Asthma comes on in the night, as it generally

* Bell on the Nerves, p. 226.

does, the patient awakes with a sense of suffocation; he starts up, and instantly begins to breathe by means of his voluntary muscles, and instinctively fixing his arms, he alters their relative position to the chest, making them a fulcrum, so that the muscles of the extremities act upon the trunk,—in short, breathing becomes a sensorial process, and the patient dare not go to sleep while the fit lasts; nor should the practitioner attempt to put him to sleep, until the breathing is no longer *only voluntary*. Yet we find chloroform recommended in Asthma!

Cardiac Asthma.—The orthopnœa which results from disease of the heart or other cause of pulmonary obstruction, is a symptomatic, and not a primary affection;—it illustrates the sympathy which exists between the glandular function of the lungs and the respiratory system. This Asthma is of course more irregular in the character of its attack and duration than idiopathic nervous Asthma; a paroxysm supervening on any cause affecting the current of blood in the lungs.

Sir B. Brodie mentions the experiments of M. Delile with *upas tiente*, a poison which "M. Delile describes as causing death by occasioning repeated and long continued contractions of the muscles of respiration, on which it acts through the medium

of the spinal chord without destroying the functions of the brain."*

3. *The Motor Nerves of the Organic System.* —The muscles acted upon by the sensorial and respiratory classes of nerves, are those of "animal life." The nerves of the class now to be considered, are distributed to the "Organic" musculer fibre,—the Heart, the Stomach, the Intestinal Canal, the Uterus.

I shall not attempt to discuss the question of muscular irritability;—my object is to establish a correct classification of the different departments of nerves, and I wish to limit myself to the powers of this great system over functions.

It is at this part of my subject that the interesting experiments of Sir B. Brodie become peculiarly valuable, and I propose making free use of them.

The Woorara is a poison which suspends the nervous energy both of the sensorial and respiratory systems, but leaves the organic muscles unaffected. "A small quantity of Woorara in

* Brodie's Physiology, p. 72.

I have not been able to obtain sight of Mr Delile's dissertation, but the above quotation is sufficient to prove that this poison acts on the respiratory system, without affecting the sensorial.

powder was applied to a wound in the side of a Guinea pig. In ten minutes afterwards the animal was unable to walk; then he became quite motionless, except some slight occasional convulsions. He gradually became insensible, the respirations were laboured, and at the end of fourteen minutes from the application of the poison, the respiration had entirely ceased and he was apparently dead; but on opening the thorax, the heart was found acting seventy times in a minute, circulating dark coloured blood, and it continued to contract for several minutes afterwards; on dissection no preternatural appearances were observed in the brain; nor was there any other appearance in the limb, than would have arisen from an ordinary wound."*

In other experiments with the Woorara, Sir B. Brodie found that he could maintain the circulation for upwards of an hour by artificial respiration;—and that when the quantity of poison was not in excess, and by keeping the animal in a temperature of about 90°, he was enabled to overcome the injury inflicted by the poison on the sensorial and respiratory nervous powers, so as to restore life, but in the reverse order in which the poison had acted.

* Phys. Res., pp. 57—8.

"Some Woorara was inserted into a wound in a young cat; she became affected by it in a few minutes, and lay in a drowsy and half sensible state, in which she continued at the end of an hour and 15 minutes, when the application of the poison was repeated. In four minutes after the second application respiration had entirely ceased, and the animal appeared to be dead, but the heart was still felt acting about 140 times in a minute. She was placed in a temperature of 85° of Fahrenheit's thermometer, and the lungs were artificially inflated about 40 times in a minute.

"The heart continued acting regularly.

"When the artificial respiration had been kept up during 40 minutes, the pupils of the eyes were observed to contract and dilate on the increase or diminution of light, saliva had flowed from the mouth, and a small quantity of tears was collected between the eye and eyelids; but the animal still continued perfectly motionless and insensible.

"At the end of an hour and forty minutes from the same period, there was slight involuntary contractions of the muscles, and every now and then there was an effort to breathe. The involuntary motions continued, and the efforts to breathe became more frequent; at the end of another hour the animal, for the first time, gave some signs of sensibility when roused, and made spon-

taneous efforts to breathe twenty-two times in a minute. The artificial respiration was discontinued—she lay as if in a state of profound sleep, for forty minutes more, when she suddenly awoke, and walked away. On the following day she appeared slightly indisposed; but she gradually recovered, and is at this time still alive and in health."*

In another experiment, in which Sir B. Brodie was not successful in restoring life, the circulation was maintained for four hours by artificial respiration. "Some Woorara was applied to a wound in a rabbit. The animal was apparently dead in four minutes after the application of the poison; but the heart continued acting. He was placed in a temperature of 90°, and the lungs were artificially inflated. The heart continued to act about 150 times in a minute. For more than 3 hours the pulse was strong and regular, after this it became feeble and irregular, and at the end of another hour the circulation had entirely ceased. During this time there was no appearance of returning sensibility."†

Mr Phillips, and other physiologists pursuing the same mode of enquiry with him, found that even after the removal of the brain, and the de-

* Phys. Res., pp. 78—9.

† Phys. Res., p. 79.

struction of the spinal marrow, the circulation of the blood, and the peristaltic action of the intestines, might be maintained by artificial respiration for a considerable time.

It is necessary to advert here to the fact, that although the actions and functions of organic life are carried on without the interference of the brain, and, as is seen above, may to a certain extent and for a time be maintained after its removal, still, as we should expect from what we know of mental influences, the brain has a direct power over the heart and abdominal organs, so that its sudden destruction, or severe injury, will at once affect the organic system. Thus, when Mr Phillips crushed the brain of a rabbit, the heart instantly ceased to beat, although the careful removal of the brain did not affect its action. When he applied stimulants to the brain, as alcohol, the action of the heart was increased, and the same effect was produced by the application of stimulants to the spinal marrow; increasing also, as it appeared to him, the peristaltic action of the intestines.

The influence of the brain on the organic viscera is peculiar, and very interesting,—illustrating the distinctions in its mental and bodily functions. It is evident that the sensorium, in a normal state of the system, does not interfere with

organic operations. Yet the emotions and passions of the mind exercise a direct and immediate influence not only on the involuntary muscular actions, but on non-muscular vessels, and on secretions. Thus, sympathy will immediately increase the secretion of tear; shame will instantly deprive the capillaries of the face and neck of tone; fear will suspend the secretion of saliva, and almost stop the heart's action, while anger will render it inordinate; and the same passions will act on the muscular apparatus of the alimentary canal, and on the various abdominal secretions. Knowing then, as we do, that the functions which the mind thus acts on, are not immediately under the sensorial power, we must conclude, that there is a nervous agency called into action on these occasions, which is otherwise in abeyance, and I think it is not too hypothetical to conclude that this nerve must act on the *nerves of function*, and not directly on *functional structure*. Such a nerve would be peculiar, being neither a motor nor a sentient nerve, but strictly a medium of communication between the brain and systems of nerves. It seems to me probable that the vagi nerves are appropriated to this purpose; these nerves are described as sending branches to every organ, from the fauces to the liver, and to the solar

plexus—not merely to the muscular parts, but to the glandular and to the secreting. I have no wish, however, to enter further into the anatomical and physiological question with reference to this point; but in pathology, it is necessary to keep in mind that the brain may thus influence functions which it does not normally conduct. I may add that there seems to be in health no reciprocal communication from the organic department to the brain, so that the nerves which carry the cerebral behests are probably solitary, having no sentient nerve accompanying them.

It is not, however, the brain only that influences the heart's actions,—a blow on the stomach —the *coup de grâce*—will instantly stop its action. Sir B. Brodie found that the infusion of tobacco injected into the bowels, influenced the heart's action in a dog even after the head had been removed, the circulation being maintained by artificial respiration. He says, "I then injected into the stomach and intestines nine ounces of infusion of tobacco. At the time of the injection, the body of the animal lay perfectly quiet and motionless on the table, the heart acted regularly 100 times in a minute. Ten minutes afterwards, the pulse rose to 140 in a minute."*

* Phys. Res., pp. 50—1.

The state of the circulation in violent intestinal inflammation, is equally illustrative of the influence of the floating viscera on the heart. Mr W. Phillips says, "The author has seen the powers of circulation so enfeebled by violent inflammation of the alimentary canal, that within 12 hours after the attack, it was impossible to obtain 4 oz. of blood, although large veins in both arms and both legs, and one of the temporal arteries were opened, no blood having been taken previously, and the patient at the time of the attack having been strong and in good health. He died within 24 hours of the commencement of his disease. On inspecting the body, the whole of the alimentary canal was found inflamed, and a small spot on the stomach of a purple colour, without any other morbid appearance."*

As a poisonous dose of arsenic, whether swallowed or absorbed from a wounded surface, invariably occasions inflammation of the mucous membrane of the alimentary canal, it is probable that the enfeebled and intermittent state of the heart's action, which so early characterises the effects of this poison, may be attributable to the influence of the sympathetic system of nerves on the organic motor system.

* Phillips on the Vital Functions, p. 322.

It is proved then by the experiments above quoted, that organic muscular action is not destroyed by the suspension of the sensorial and respiratory systems, and that it will continue in vigor for a time under artificial respiration after the removal of the brain, and destruction of the spinal marrow.

But it is not only the continuance of organic actions under the suspension of the sensorial and respiratory systems that establishes the distinctive powers of this class of nerves. Agents acting on the heart, without in the first instance affecting the other powers, illustrate the classification from the other side of the question. Sir B. Brodie's Experiments with the Upas Antiar establish this. "About two grains of this poison were made into a thin paste with water, and inserted into a wound in the thigh of a dog. Twelve minutes afterwards he became languid, at the end of fifteen minutes the heart was found to beat very irregularly and with frequent intermissions, after which he had a slight rigor. At the end of twenty minutes the heart beat very feebly and irregularly,—the dog was languid, sick, and vomited, but the respirations were as frequent and as full as under natural circumstances; and he was perfectly sensible. At the end of twenty minutes he suddenly fell on one side and was apparently dead.

I immediately opened the thorax, and found the *heart distended with blood* in a very remarkable degree, and to have entirely ceased contracting. There was one distinct and full inspiration after I had begun making the incision into the thorax. The cavities of the left side of the heart *contained scarlet blood*, and those of the right side *contained dark coloured blood*, as in a living animal."*

The upas antiar, therefore, acts immediately on the heart, and only indirectly on the sensorial and respiratory powers; but we may conclude that it is through the motor nerves that the heart is affected, because what may be considered the mechanical, or at least the natural stimuli of the organ fail to excite it to action,—both sides of the heart, in the above experiment, "were distended with blood to a very remarkable degree," the blood being in its normal conditions.

The above argument has established:—

(1.) That the sensorial nervous system may be suspended without affecting the respiration or the circulation.

(2.) That the involuntary source of respiration may be deprived of its control over the chest, while the sensorial and circulative systems are only secondarily affected.

* Physiological Researches, p. 60. The Italics are mine.

(3.) That the sensorial and respiratory classes of nerves may be destroyed, and the organic motor nervous system retain its powers. And that this third division of the nervous economy may be annihilated by causes which do not primarily affect the energy of the two former nervous systems.

4. *The Sympathetic or Secerning Nervous System.*—The three departments of nerves which I have now discussed belong to the *Sentient* and to the *Motor* systems. The class, the distinct nature of which I shall now endeavour to establish, is that on which are dependent assimilation, nutrition, secretion, and elimination; in so far as nervous influence is engaged in those processes.

Whether the semi-lunar ganglia and solar plexus shall be regarded as endowed with an independent vis nervosa, or be viewed as possessing merely delegated powers from the Brain, it is clear that in a normal state of the frame the organic secerning nervous system is not interfered with by that organ.

The ramifications of this system are not less extensive than those of the cerebral nerves; its branches being distributed wherever there is a vascular structure,—with the exception, perhaps, of the brain itself, in which the blood-vessels are

not proved to be accompanied by branches of the sympathetic system.

The importance of this great division of nerves to physiology and pathology is sufficiently evident; and I believe it to possess, in addition to its admitted influence over secretion, nutrition, &c., the power of regulating the flow of fluids in non-muscular vessels, and of influencing by a reflex action, the organic muscular fibre. Its conditions, therefore, are worthy of constant consideration in the treatment of disease.

The fact that the muscular coat of the intestines will continue to act after the gut is disconnected from the sources of nervous influence, is, in my opinion, of no weight with reference to functional processes; and it has, I think, been too much dwelt upon by physiologists. The alimentary canal has a succession of functions to perform on which the strength and health of the body depend, and these call for secretions, defecation, absorption, and muscular action, in turn, as the exigencies of the system may demand.

Thus assimilation requires material prepared for its purposes by mastication, a normal state of the mucus of the alimentary canal, the secretions of the liver and pancreas in due quantities, an energetic state of the lacteals, and a controlled muscular action in the intestines. All

these requisites, however, are not continuously called forth, nor in regular order, but the whole is occasional, and even then one process may be more in request than any of the others; defecation may be slow, or the lacteals inactive, so that it may be necessary to retard the progress of the aliment in the canal; or, from the nature of the ingesta, a greater supply of blood than usual may be required by the capillaries. In short, the succession of processes involved in assimilation, as in every secretion, could only be effectually promoted by a *controlling power;* and this unquestionably must be nervous.

In the sensorial system there are sentient and motor nerves which, although in one sheath, do not act on each other. Thus, if the hand have been unconsciously brought into contact with hot iron, the skin may be destroyed before the nervous circle is completed,—the sentient filament having to communicate with the brain before the motor nerve is called into action. In the organic nervous departments, a similar arrangement appears to me to exist; but the brain is not in the circle; and there is not in my mind any doubt as to one use of the ganglions on the spinal nerves being to effect this required communication between the two classes of the organic nerves:—the sensitive sympathetic, in the same sheath

with the motor nerve of the spinal ganglionic system, is thus enabled, as in the case of the cerebral system, to excite or regulate the intensity of organic muscular action, without going beyond the ganglion appropriated to the locality. And it is probable that this sensitive nerve may be enabled to extend its action beyond the ganglion, so as to come into communication with the sentient portion of the cerebral system, and so bring the state of the viscera in disease, under the cognizance of the brain.

It will be seen by referring to Sir B. Brodie's experiments* with the upas antiar, that although the heart had ceased to act, its cavities were distended with florid and dark coloured blood. In another of his experiments with that poison he says: "On opening the thorax, I found the heart to have ceased contracting. It was much distended with blood, and the blood in the cavities of the left side was of a scarlet colour. There were two full inspirations after the incision of the thorax was begun."† Proving that the power which effects the circulation in the veins, had retained its influence after the heart had ceased to act on the blood. The upas antiar, therefore, and other poisons which act similarly on

* Vide supra, p. 25.

† Phys. Res. p. 61.

the motor organic class of nerves, do not affect the sympathetic system, which continues to excite the current of blood in the veins until the gorged and silenced heart interrupts its further progress.

A fit of ague is ushered in by lassitude and debility, the nails, on examination, are blue, the lips and cheeks soon become livid, the whole periphery shrinks, the pulse is thready, and the action of the heart feeble, the breathing hurried and oppressed, a general state of rigor ensues,—accompanied often by cramps,—and for a time all attempts to restore the natural temperature of the body prove unavailing.

The balance of the circulation is upset, the arterial blood is deficient and the veins are loaded. This *disease* (for the *ague* is truly the disease) generally after a time yields, the circulation of the veins is restored, oxigenated blood once more reaches the heart, colour, heat, &c., return ;—but the heart is supplied in excess, reaction is the result, and what is called the "hot stage" of the intermittent is established.

Reaction may not, however, take place ; the "cold stage" continuing, torpor and coma follow, and death, from venous congestion is the result. I have, as is mentioned in a previous page, seen

this termination of ague prevail epidemically in India.

Cholera asphyxia affords an example of a disease arising from venous remora, which still more strikingly illustrates the point I wish to demonstrate. In cholera, as in ague, the patient may discover the accession of the disease by the blueness of his nails,—or even when still engaged in his usual occupation, his friends are struck by his sunken features and livid colour,—he may scarcely admit that he is ill; his pulse, however, will be found thready, it may even be imperceptible, his skin will be deadly cold; he will own that he has had frequent motions, and cramps in his feet or hands; in short, he is far advanced in the fatal disease. Cholera and ague differ; in the absence of shivering in the former, and of the characteristic gastro-enteric evacuations in the latter.

In cholera, from the outset, the arterial circulation fails;—there is suspension of the arterial secretions—tear, saliva, urine, &c., and the post mortem examination exhibits empty arteries and gorged veins.

Now in both of those diseases the patient retains the energy of the sensorial and respiratory powers. In cholera, long after the pulse has ceased to beat, and when the flutter of the heart

can scarcely be perceived, when the sufferer is like a corpse, he will give you his hand, and answer you quite collectedly! As, however, the extent to which the system is affected, and the extent of the functions that have failed, point evidently to the loss of a *nervous power*, we must turn to the organic nervous divisions in search of the immediate cause of diseases, which we must conclude belong to the systems of organic life.

The pathognomonic symptom of cholera is in the characteristic abdominal evacuations, which also presents a pathological difficulty. For after all secretion has ceased, excessive quantites of watery fluid are discharged from the alimentary canal, and after death the same fluid is found loading the intestines. Even if there were not otherwise sufficient evidence to prove that secretion, properly so called, had ceased from the accession of the disease, the fact of empty arteries and the absence of arterial blood, are sufficient to justify the conclusion, that the cholera ejection is not the result of secretion. In a later portion of this treatise I shall enlarge on this point; at present my object is to establish, if I may, the class of nerves to the failure of which the disease is due. The active state of the gastro-enteric muscular fibres sufficiently proves that in so far

as their action may depend on the organic motor nerves, that system retains its energy. The heart from not being duly supplied with blood, is, of course, in a state of inactivity. There is, however, an experiment of the greatest interest which proves that the heart in cholera is only idle from the deficient supply of blood.

Every analysis of the cholera ejections, proves that they consist almost entirely of the serum of the blood in an unaltered state. It is due to Dr O'Shaughnessy that the same fact is established synthetically, if I may say so. This physician finding that he had a disease to treat which rapidly discharges from the system the watery portions of the blood, (and as he compliments my work on cholera, I may conclude that he gave due weight to my reasoning on this point,) resolved to try the effect of mechanically restoring it by injecting into the veins, an aqueous solution containing a small proportion of the muriate and carbonate of soda.

A case treated in the hospital of which I had joint charge with my friend Dr Begbie in this city, in 1832, by injection of the veins, will illustrate the correctness of Dr O'Shaughnessy's reasoning, and the point I am endeavouring to establish, viz., the normal state of the muscularity of the heart in cholera.

"*4th July.*—Alex. Haig, 52 years of age, dissipated, admitted at half-past 6 A.M. Pulse at wrist gone, humeral artery beating indistinctly, extremities cold and blue, face collapsed and cadaverous, cramps chiefly in the thighs,—reported to have had much vomiting and purging, and cramps early in the morning."

All the usual remedies having been resorted to in vain, and as the man was evidently sinking, "at 11 A.M. the saline infusion was practised to 10 lbs. which restored colour, and pulse—114, heat to the body, skin moist and warm, voice strong; although he vomited a little blood during the progress of injection, the characteristic vomiting and purging ceased. 2 P.M. sinking again. Infusion to 10 lbs. repeated with similar results. 10 P.M., in consequence of return of collapse, 6 lbs. more infused." After this there was no return of collapse. Urine was secreted, and the alvine discharges became feculent. This poor man struggled through a succession of irregular reactionary symptoms until the 12th of July, when he died of inflammation of the brain.*

Nothing can be more interesting in medical practice than this wonderful experiment of Dr O'Shaughnessy. The change, almost instanta-

* Journal of Cases.

neously effected, from a livid whispering corpse, to a florid, strong-voiced man, is truly marvellous, and the release from terrible suffering to ease, very gratifying. It may be likened to Sir B. Brodie's restoration of life by artificial respiration after poisoning with Woorara, with this difference,—that the poison suspends the sensorial and respiratory powers, but leaves the organic division of nerves uninjured :—whereas cholera suspends the energy of the sympathetic system, without directly affecting the sensorial and respiratory classes of nerves :—and, as is proved by the above *experiment*, and by the active state of the muscular coat of the alimentary canal throughout the disease, the actions normally under the influence of the organic motor-nerves, are not destroyed by cholera.

Sir B. Brodie, after three hours of artificial respiration, overcame the otherwise mortal injury of Woorara on the animal nervous systems. In the above quoted case of cholera, after persevering for eleven hours,—in the course of which, twenty-six pounds of salined water were injected into the veins,—the morbid condition of the circulation was subdued, and the patient saved from *dying of cholera*.

I have now, I trust, demonstrated the distinct

pathological bearings of the classification of the nerves I have attempted to establish, viz. :— that while there are two great divisions of the system—the *animal* and *organic;* these are subdivided, each into two departments. The *animal*, into the sensorial, and involuntary respiratory ;— the *organic*, into the motor and secerning systems ; and that each of these divisions and subdivisions is liable to be influenced, by disease and medicinal substances, without affecting the others.

Before entering on a few practical deductions, it is necessary that I should endeavour to elucidate a subject of the greatest importance, in explanation of the views I entertain on pathology and therapeutics, viz. :—the department of the venous system, which belongs exclusively to the abdominal viscera.

THE PORTAL VENOUS SYSTEM.

I am now enabled to enter more fully into this subject than when treating of the circulation of the blood.

The ejections in cholera consist mainly of the serum of the blood in an unaltered state, which, in a bad case, is so effectually drained from the system, that the remaining blood is of the consistence of tar, and wholly unfit for the purposes of life. This excretion continues to be discharged with great force after the prostration of strength is so great, that the sufferer, with his livid colour, death-like coldness, and sunken features, is more like a subject experimented upon by galvanism, than a living body! In these circumstances, the circulation having been long at an end, the question is, whence is this enormous quantity of serum derived?—it is probably poured into the intestines by the capillary vessels. But how does the blood reach these, to enable them thus to drain off the serum from the crassamentum?

This is a point which I regard as one of very great importance; not with reference only to the extraordinary disease of which it is so prominent a feature, and to the mortality of which it so

much contributes; but as affording evidence of a venous determination of blood to the alimentary canal, which may not only occur in disease, and under the influence of medicinal agents, but which may exist in a normal condition of the system. In health affording the means of ridding the venous blood of the more peccant colluvies,—and fulfilling the office of removing the results of incipient decomposition in an ever-changing frame,—which the veins convey for the purpose of being discharged from the body. In short, that in so far as the feculent contents of the intestines are an excretion from the blood, I believe the function to be *venous*, and not *arterial*. Indeed, it is impossible to believe that the *pure* blood which reaches the left side of the heart, retains the pabulum for feculent secretion; and, that the capillary arteries which secrete the mucous of the intestines, are also appropriated to the deposition of feces.

There is nothing in the Portal System of veins —including under this term all the veins of the abdominal viscera—there is nothing to prevent a current in either direction, to or from the intestines. That the mesenteric veins are not indispensable to the hepatic secretion, has been proved by instances of irregularity, in which the vena portæ passing direct to the vena cava, did

not ramify in the liver, yet there was no apparent want of bile :—and that the current of blood in the mesenterie veins is liable to be directed either from or to the heart, is proved by observations of Mr Phillips,—who found, in the mesenterie veins of rabbits recently dead, even when he had tied the aorta, that the blood still moved—"stopping and going on, and sometimes moving backwards and forwards in the same vessel."*

When too large a dose of croton oil is taken, there very quickly ensues violent action in the gastro-enteric canal,—a great quantity of watery fluid is discharged from the stomach and intestines, unaccompanied by arterial excitement,—the reverse indeed. Dr Turnbull Christie says, in his work on the cholera :—"A powerful dose of physic, occasioning an abundant secretion from the bowels, is frequently followed by a small pulse and an unpleasant sensation of coldness over the surface of the body. This was illustrated in a most striking manner in the case of one of my own servants, a young Mahomedan, who took too large a dose of the croton tiglium, which occasioned hypercatharsis. His evacuations after a time consisted only of mucous and serum, his pulse was scarcely perceptible at the wrist, his extremities

* W. Phillips, p. 178.

were cold and his features contracted. He was in this state when I first saw him, and from all these symptoms I immediately concluded that he had an attack of cholera." *

In addition to such symptoms as these described by Dr Christie, I have found cramps, like those of cholera, attack a patient under the influence of a medicinal dose of croton oil.

It is evident, therefore, that a powerful hydragogue cathartic, such as the croton tiglium, or elaterium, while it occasions excessive serous discharges from the alimentary canal, depresses the arterial circulation, so as to induce for a time, a condition of the system similar to what occurs in cholera, and in which the alimentary ejections (according to the views I am maintaining) must be derived from the mesenteric veins.

The determination of the requisite material to secreting organs is a subject of the greatest interest. The rapid secretion of the kidneys under the influence of mental anxiety, is illustrative of the extent to which their function may be excited in health. While in a diseased state of the secerning process, as in diabetes, a quantity of urine may be voided in a given time, more than double the whole ingesta,—cases being on record in which upwards of thirty pints have been

* Christie on Cholera, pp. 14, 15.

discharged in twenty-four hours. In these circumstances, the secreting organs must not only be sufficiently supplied with blood; but we must conclude that there exists an *elective* principle, capable of determining the pabula of the morbid secretion to the kidneys, analogous to what takes place in galvanic decomposition, in which a component portion of a substance is attracted to the positive or negative pole.

It is probable that the excessive quantity of fluid which continues to be discharged from the intestinal canal in cholera, after the circulation of the blood has ceased, is derived from the veins generally, by a process of *determination*, and not merely drained from the gorged mesenteric vessels.

It is not, I think, overstraining analogy to refer to galvanism in attempting to explain vital processes;—and I trust I may be excused entering more fully into this point.

Elimination in all its phases evidently depends on the agency of the sympathetic nerves, which are so freely distributed to every blood vessel in the body. Secretion may not require more than that the *power* controlling the capillary circulation should be enabled to regulate the supply of blood according to emergencies. Excretion is a totally different process. The object of this

function is to expel from the system the effete and injurious products of vital processes, contained in the blood; and we may conclude that it would not suffice to purify merely the portion of the blood circulating in the emunctories, but that it is necessary that the colluvies to be discharged, should be determined from every quarter of the circulation to the emulgent locality.

Galvanic action, in decomposing an alkaline sulphate in solution, determines its acid base to the positive, and its alkaline to the negative pole; and the acid may even be made to pass through an alkaline medium without the usual chemical combination resulting.

If, therefore, the speculation I have ventured to propound be admitted, viz., that the excretory function of the enteric mucous membrane is effected by the mesenteric veins,—and if the above illustration be apposite, a retrograde current in the Portal veins would not be indispensable.

Mercury.—There is not, in the list of remedies, a more valuable medicine than mercury; yet unhappily its *abuse* has led even eminent practitioners of the present day, wholly to discard it from their prescriptions. I shall be truly gratified if the views I am about to expound of its modus medendi, should help to restore it to its

proper place as the sheet anchor in the treatment of many diseases.

The experiments I shall here refer to in illustration of the effects of calomel, have the advantage of being those of pathologists who entertained totally different views from mine.

Dr Turnbull Christie says: "Two drams of calomel in a little butter were given to a full-grown dog on an empty stomach. Several hours afterwards it was purged two or three times, but it did not vomit. About twenty hours after the calomel had been given, the dog was decapitated. The mesenteric veins were more distended than natural. A good deal of mucous matter was found lining the surface of the stomach. A small quantity of calomel was found in the splenic end of the stomach, and there the mucous membrane was of a rose colour. The pyloric end contained no calomel and was perfectly white. The gall bladder was distended with bile. The small intestines contained a good deal of mucous and bile and their mucous coat was perfectly white. The large intestines were filled with a dark, brownish, somewhat feculent matter, and their mucous membrane was of a light rose colour. This experiment illustrates very well the action of calomel."*

* Christie on Cholera, p. 34.

Dr C. adds that Sir James Annesley's experiments "afford the same general result as those related above, for large doses of calomel always increased the secretion of the gastro-enteric mucous membrane, and rendered the internal surface of the stomach (and bowels) lighter in its colour."*

Sir James Annesley also, in his experiments, found the veins in the abdomen "beautifully injected," and his inference is "that the natural and healthy state of the stomach and intestinal canal is high vascularity, and that the operation of calomel in large doses is directly the reverse of inflammatory."†

Mercury then, in addition to its admitted influence on the secretion of the liver, acts as a *tonic* on the capillaries of the gastro-enteric mucous lining,—this membrane having been found in all these experiments with calomel "perfectly white." And also as a stimulant to the excretory function of the bowels:—"the large intestines were filled with a dark, brownish, somewhat feculent matter." And these effects, even in experiments in which the animals were decapitated, were attended with "mesenteric veins more distended than natural;"—or according to another

* Christie on Cholera, p. 36.

† Cal. Med. Trans. V. 1, p. 220.

experimentalist,—in every instance the venous system was found "beautifully injected."*

Such results cannot, I think, be explained on the principle of irritability, irrespective of nervous influence. Mercury reduces the vascularity of the enteric mucous membrane, acting of course on the arterial capillaries. And while it increases the hepatic secretion, it stimulates the emunctory function of the intestines,—proving its influence over the entire portal system. We have thus a combination of actions only to be accounted for by admitting the interposition of nervous agency. And my hypothesis is, that the therapeutic effects of this medicine are to be attributed to its acting as a *stimulant* on the sympathetic system of nerves.

A case of dysentery treated with mercury, appears to me to illustrate this conclusion. The violent attacks of this disease, so common in India, are attended with indescribable agony—tormina, tenesmus,—continual urgent alvine calls, scarcely permitting the patient to leave the commode—small quantities of blood and mucus being passed with terrible straining, and without relief; —fixed pain in a part, or in the whole course of the colon; there is high fever, and alarming debility. In such circumstances, a scruple of

* Annesley.

calomel will act as if it were an anodyne; and the second or third repetition—every five or six hours—will completely master the disease.

The ratio symptomatum in dysentery, and the modus medendi of mercury may, I think, be satisfactorily explained on the views I have been endeavouring to illustrate. Thus there are inflammation, and depraved secretion, discharge of blood from the distended capillary vessels of a portion of the enteric mucous membrane; and, whether as cause, or effect, the secerning nervous system is involved in the morbid state of the secreting surface. The motor-organic system of nerves is communicated with, and the muscular coat of the intestines is thrown into diseased action, producing, from the inflamed state of the intestines, tormina and tenesmus; the brain is brought into cognizance of these morbid changes, through the sensitive branches of the sympathetic, and the sentient nerves in the spinal column;—the normal functions of the portal venous system being suspended by the influence of the disease on the sympathetic class of nerves. Mercury, in reducing the vascularity of the enteric mucous membrane, overcomes the inflammation,—stops the discharge of blood and depraved secretion;—and, in restoring tone to the portal system, re-establishes the excretory function of the bowels:—thus respond-

ing to all the indications of treatment in dysentery.

I do not think this prolonged argument exceeds the importance of the subject, and I trust it may be found to justify my belief,—that the mesenteric veins are the medium by which excrementious matters are discharged from the blood.

PRACTICAL DEDUCTIONS.

I am not at present prepared to carry out fully the deductions to which the above observations, views, and conclusions, may be extended for nosological arrangement generally. Nor shall I attempt to prove all their value in reference to therapeutics. But it must be evident, that if the divisions I have illustrated of the nervous system be correct;—and if each class of nerves be liable to take on disease, irrespective of the others; there is established a sure foundation for the accurate classification of morbid conditions, not entirely local. While, it is equally certain, that if medicines act on one or other of those departments of nerves individually, there is a hope that we shall have less of empiricism in the treatment of disease; and that our pharmacopæias will be freed from the contradictory qualities, so often ascribed to the same medicine.

I regard cholera-asphyxia to be one of the most instructive diseases we have. In a few hours

duration it reduces the system to a more thoroughly morbid condition than will result from several days of our worst fevers ;—this not only from the retention of impurities in the circulation, consequent on the failure of secretions and excretions, but from the loss which the blood sustains by the serous discharge. When, therefore, the virulence of the exciting cause of this disease subsides, the system is left in a state of the greatest peril ; —the blood not only retaining what ought to have been discharged from the circulation ; but, being deprived of its serum, is in a semi-fluid state ; so that even if the full energy of the circulating power be restored, it is not fit to be propelled through the vascular system.

In ague the venous remora is not only usually of short duration, but the suspension of functional processes is partial, and there is not the fatal discharge of serum ; so that when reaction sets in, there is rather a redundancy, than a deficiency of blood ; with which, the heart being rapidly surcharged, a state of fever results. While the "sweating stage" which follows, may be regarded as an evidence of the merciful manner in which our frame is prepared to overcome deleterious conditions ;—the other functional processes being at the same time excited, the colluvies, which the suspended actions had left in the blood, are expell-

ed. The experienced practitioner, however, is not contented with merely "pouring in quinine" during the intermission,—he attends particularly to the alvine and urinary exeretions, and to the state of the skin,—thus seeuring the effieient action of his tonie. In such instances as I have referred to in a previous section of this essay, when the agued state does not subside, the case must be treated as one of eongestion, and the lancet freely resorted to.

In cholera, when the attack has been severe, the powers of nature will not suffice—reaetion is slowly developed ; and from the tar-like state of the blood, and the morbid eondition of the system, sueh a fever may ensue, as we might expeet, when there are not only eorrupt colluvies to be diseharged, but important component portions of the blood to be restored. These eonsiderations at onee explain the great value of the Indian, I wish I could call it European, praetiee of veneseetion in eholera. In my work on that disease, I have entered fully into the rationale of this portion of the treatment, to which I must refer, observing here that the objeet in bleeding, is to relieve the powers of the system from an unmanageable load of deteriorated blood ; and it is of the greatest eonsequenee that as early as possible in the attack, the turgid state of the portal and

mesenteric veins should be overcome, so that every aid may be given to the sympathetic system more readily to recover its normal powers. I may add, that I have before me an abstract of the results of venous depletion in the practice of the Castle Hill cholera hospital in 1832, not only while I was attached to it, but after my friend Dr Craigie succeeded me. There were 62 cases in which bleeding was resorted to; of these 41 recovered, and 21 died; and it almost invariably happened that when from 16 to 24 oz. of blood could be abstracted, the patient recovered; and, of the V. S. cases which did not recover, there appears seldom to have been obtained above 12 oz. of blood. It must also be kept in mind that the patients of whom we had charge in that hospital, were not only poor and destitute, but almost invariably dissipated—many of them labouring under organic diseases.

My estimation, therefore, of venous depletion in this disease remains unchanged, and I sincerely wish I could impress its importance on my professional brethren in this country.

As may be expected from what I have endeavoured to establish with regard to the therapeutic effects of calomel, I consider that medicine the mainstay in the treatment of cholera, not only in large and often repeated doses in the earlier stages

of the disease, but in more moderate quantities during prolonged reaction. As, however, in the observations I have to make on the use of this medicine in fevers, I shall take occasion to enlarge on the best mode of its exhibition, it is sufficient to state here, that the object being to restore the blood to its normal condition, mercury, from its effects on the enteric emunctory function, is invaluable throughout the treatment.

I am very doubtful as to the value of opium in cholera after the collapse is fairly established. Opium appears to me to act primarily on the organic nervous systems, stimulating the motor class, but acting as a sedative on the sympathetic system. Thence, in the first instance it excites the heart's action ; this is, however, of short duration, as the sedative effects of the medicine on the source of energy in the non-muscular powers of the circulation, soon render the current of blood sluggish, and congestion follows, affecting of course the cerebrum, and consequently the sensorial system of nerves. These are not the effects aimed at in the treatment of cholera. Nor do I believe that as an anti-spasmodic, opium can, in the state of the circulation in cholera, prove useful :—the cramps in this disease result from the failure of arterial blood and venous congestion ; and it is only by removing the latter and

restoring the former, that any important effect can be hoped for, in relieving that source of great suffering—the almost universal cramps.

Stimulants in the stage of collapse seem to produce little effect; they may, however, assist in maintaining the energies of those nervous departments which are not primarily affected by the disease, and on which the continuance of life depends, until reaction sets in.

I have, in detailing Haig's case, page 35, proved the effect of *directly* restoring the lost watery portion of the blood. Were I again to adopt "venous injection," I should freely bleed the patient during the process, and perseveringly exhibit mercury throughout the subsequent treatment.

An Indian practitioner, Dr Mosgrove, some years ago recommended a very different mode of treatment with regard to administrating cold water, from that usually adopted; he had been led to it, I think, by the recovery of a moribund patient who had been left to die near a tank, to which having crawled, he had freely partaken of the beverage usually denied, but in all cases so urgently petitioned for. Dr Mosgrove afterwards resorted to the practice of allowing unrestricted use of cold water, and although I have not the results of this treatment by me, the im-

pression on my mind is, that it was wonderfully successful; and assuredly if the lost serum of the blood can be thus restored to it, Dr Mosgrove's practice would respond to the most important indication in the treatment.*

Although in illustrating the therapeutic effects of mercury, I have referred pretty fully to its value in the treatment of dysentery, still there are some points of a practical nature which I regard it necessary to advert to here. It appears to me that the generic distinctions between dysentery and diarrhœa, are not, in this country, kept sufficiently in mind by the practitioner, and consequently that the methods of treatment, which ought to differ as much as, in point of fact, the diseases do, are confused and indistinct.

In dysentery there are inflammation, and depraved secretion in a portion of the enteric mucous membrane, small mucous motions and straining, and a suspension of the excretory function of the

* Dr Steven's "Saline Cure" tends, I think, to substantiate the beneficial effects of freely administering cold water in cholera. He gives sedleitz powder, of course in water, seltzer water, soda water, or "pure water ad libitum." And however capable his saline medicines may be of restoring the crimson colour of the blood, I suspect they can only prove effectual as a cure for cholera, when water, by absorption within the alimentary canal, may be restored to the blood.

bowels. Whereas in diarrhœa there are free motions, and no straining, and although there may be griping, there is none of the tormina of dysentery. In the treatment of diarrhœa opiates and astringents are indicated. If these remedies be resorted to in dysentery—too frequently the case in this country—the disease will be aggravated and the sufferings of the patient increased. Such being the case, it is, I think, unfortunate that one of our principal medical authorities, should have applied the term "anti-dysenteric" as one of the therapeutic qualities of opium.

Fever.—Idiopathic continued fever is ushered in by languor and indifference to objects which usually interest, inaptitude of application, an obtuse state of the intellect—there may be mental alienation. All the symptoms proving that there is diminished energy of the brain; not only affecting the sensorial system of nerves, and occasioning sluggishness of the sentient and voluntary powers, but, like an injury to the head which extends to the whole nervous economy, the cerebral condition in fever produces indisposition to bodily exertion, a torpid state of the circulation, and a deranged state of the secreting and other functional processes:—shivering may ensue, as occurs in every shock to the powers of the system; but not the

regular rigor of ague. After a shorter or longer time, reaction sets in, and the pyrexial state is established,—head symptoms, however, continue to characterise the disease; and throughout its course the abnormal influence of the brain over the secerning and emulgent processes continues.

The resemblance of the commencement of fever to many of the symptoms of ague, has led to mistaken views of the pathognomonic characters of the diseases, and to confounding two distinct affections of the system. Thus synochus is regarded as the *result* of the debility, mental and bodily, with which the disease sets in, and is viewed in the same light as the *reaction* of ague. No doubt the hot fit of the intermittent does not always, after a short duration, terminate in the sweating stage; and there is the not uncommon occurrence, of excited action continuing,—the usual course of ague being interrupted by a remittent type of fever:—the brain may also suffer in either of the stages of an intermittent,—in the cold stage from congestion, in the hot stage from excited arterial action. For though a morbid state of the brain is a source of fever, in ague it is the result of deranged vascular action.

These diseases, however, do not only differ, as I believe, in their proximate sources, but in their remote causes. The source of intermittent ague,

which endemically or occasionally exists in particular localities, is evidently of a meteorological character,—it is probably magnetic or galvanic in its nature; emanating from the earth and not diffused in the atmosphere. The department of our nervous system, which, as it appears to me, is affected by the remote cause of ague, is that common to us, and to those lower tribes of animals, which are evidently more under the influence of meteorological changes. Continued fever, again, has its remote cause in atmospheric impurities, generated by the decomposition of animal and vegetable matter; and especially by the fomites arising from human beings too closely confined,—as, in its most virulent character, is well exemplified in gaol fever.

The results of these two maladies are as distinct as their causes. In ague, visceral diseases of the abdomen are to be dreaded; especially of that peculiarly venous organ the spleen. While in continued fever mental and cerebral affections are the tendencies to be guarded against.

We may ascribe a "vis conservatrix naturæ" to the fact, that, while one department of the nervous economy is morbidly affected, life is preserved by the other classes of nerves being free from disease. Thus the sensorial and respiratory systems perform the duty of a preserving power

in cholera, while the energy of the sympathetic system is suspended. In fever the sensorium being at fault, assistance must be sought for in the organic classes of nerves. In the treatment, therefore, while the condition of the head requires constant attention, the object should be to counteract the abnormal influence of the brain on the secerning and emunctory functions. The observations and illustrations of the therapeutic powers of mercury, as a tonic to the sympathetic system, on which I have enlarged in a previous portion of this essay, are sufficient, I think, to justify the efficacy which I ascribe to this medicine whenever the purpose is to restore the functions of the alimentary canal.

It has been proved that mercury, while it determines to the portal system, stimulates the emulgent function of the intestines. This medium, therefore, responds to the most important indications in the treatment of fever :—it relieves the vessels of the brain, and discharges from the system the accumulated impurities, resulting from suspended emunctory processes.

It is not, however, my intention to enter fully into the treatment of fever ; my wish is to illustrate the value of mercury in the disease, and to state the mode of prescribing it, which in my own practice I have generally found successful.

Having then in a case of continued fever resorted, when advisable, to an emetic, and preseribed a dose of ealomel, followed by a saline purgative,—I immediately eommenee the persevering use of ealomel in very small doses, generally combining it with antimony. Regulating the doses of the Calomel, and of James' powder, from a sixth to the eighteenth part of a grain of eaeh, (according to the age of the patients,) and administering them every two hours, night and day,—being careful that they are thoroughly triturated with refined sugar, before division. Small as these quantities are, their persevering use thus preseribed, soon produces frequent very dark-coloured, and offensive alvine motions. As the ease advanees, the charaeter of the evacuations improves,—the tongue is less dry, and begins to elean at the edges,—the pulse becomes more steady, the skin softer,—the sleep is less disturbed; and even, when as yet there may be no greater evidenee of improvement in the cerebral eondition, it is clear from the improved state of the emunetory functions, that the organic nervous system is now less under the influenee of the distempered brain, and that it may be depended upon as a "vis medieatrix" in the further progress of the treatment.

It is not, however, only in synochus and typhus

that minute doses of calomel and antimony prove invaluable; the above mode of exhibiting these medicines, acts almost as a specific in the exanthemata, and infantile fever. I cannot give better evidence of this than by stating the fact, that in twenty-five years of extensive family practice in this city; and usually in charge of three or four private seminaries for education; while I have had no casualty from measles, I have only lost three cases of scarlet fever;—in two of which the fatal event occurred within a few hours of the accession of the disease, which was only ascertained to be from scarlatina, by similar symptoms, viz: sudden sinking, in other members of the family, terminating in virulent attacks of the malady.

I trust it will be understood that in advocating the useful qualities of a remedy, which I believe to be of the greatest value in the treatment of disease, I do not overlook the importance of attention—to the state of the head in fever,—of the fauces and surrounding glands in scarlatina,—of the chest and head in measles,—and above all, the indispensable necessity of watchfulness in every serious malady, especially during infancy.

Erysipelas.—The sympathetic nerves, which are distributed so fully to the vascular system, not only regulate the capillary *power*, but pro-

bably control the *tonicity* of the arteries. In erysipelas the capillary vessels are in an atonic state; and thence, having lost the power of resisting the force of the heart, they are filled with arterial blood. This I attribute to the suspension of the nervous energy in the vessels in which the diseased state exists.

In a case of whitlow there is not only increased pulsation in the seat of the disease, but in the arteries immediately leading to the part. I believe this to arise from the morbid condition of the nerves, *not* being limited to those involved in the inflammation, but extending to the nervous filaments supplying the vessels in the immediate neighbourhood. In which the increased pulsation no doubt, is owing to the suspended energy of the *tonicity* of the arteries, so that the systolic force distends them beyond their normal calibre.

This effect of local inflammation is not limited to the arteries, the veins also seem to lose their *tonicity* in the neighbourhood of diseased parts, —becoming much distended. Thus in a case in which a mismanaged blister had produced a slough near the ankle, of a robust and apparently healthy man, and there ensued six weeks of great suffering; the veins in the calf of the leg became varicose, although the patient was in a recumbent position; and they continued enlarged until

the sore healed, when they recovered their normal size.

I ascribe the success, which invariably attends the treatment I have adopted in erysipelas, to the muriated tincture of iron acting powerfully as a tonic on the sympathetic nervous system; and I am induced to believe that the tonic effect extends to the motor organic nerves. A case recently treated will, I think, demonstrate this.

Mrs O. æt. 75. A very interesting old lady, of full habit of body, liable to severe bilious attacks, and a sufferer from rheumatism.

"*Jan.* 10, 1853.—Called to see her in the evening. Found her suffering much from headache; constant vomiting; pulse 100, full and bounding. Apparently one of her bilious attacks; but more severe than usual.

Calomel and antimony :—a cathartic in morning.

11*th*.—Has had a very restless night; bowels have acted; vomiting continues; headache, and great intolerance of light, room darkened, pulse 110.

Repeat the purgative; and to have effervescent draughts.

5 P.M.—Symptoms not improved. On examination found the scalp covered with erysipelas from ear to ear. Bowels freely acted on.

To have 20 drops of muriated tincture of iron every three hours.

10 P.M.—Pulse 98; patient calm; skin nearly natural; the nausea has ceased.

To continue the drops throughout the night.

12*th*.—Disease spreading downwards over the face. Pulse 76; patient comfortable; sickness quite gone; bowels not acted upon since yesterday.

To have a compound rhubarb pill.

Twenty-five drops of the tincture every three hours.

13*th*.—Disease advances over the face, other symptoms quite satisfactory. No fever; pulse 72.

30 drops every three hours.

14*th*.—Wonderfully improved; but the eye-lids, nose, and left cheek, much swollen and inflamed.

Continue drops every three hours.

15*th*.—Making rapid progress to recovery.

Cont. Med. u. a.

16*th*.—Going on well.

17*th*.—Up, and declares she is quite well.

Continue drops.

18*th*.—Getting fast well. Drops every four hours.

20*th*.—Quite strong. Erysipelas gone. 30 drops twice a-day.

21*st.*—Well.

Finished the second oz. of the tincture to-day."*

In the above case, the patient, 75 years of age, of a full habit of body, and of a pyrexial diathesis, continued in a high fever, 24 hours after I was called to see her, and 48 hours from her seizure, when I discovered that the cause of the symptoms was erysipelas of the whole head. She was immediately put on 20 drop doses of the tonic tincture every three hours ; which, after the third dose, is found to have acted so effectually as a *calmative*, that the febrile excitement is gone, nausea has disappeared, and the pulse 12 beats down. And next morning, after taking 120 drops of the medicine in about 15 hours, although the local affection is not arrested, all the constitutional turmoil is so completely quieted, that the pulse is reduced to 76, and the patient "quite comfortable." All this without any perceptible emunctory effects, to account for the change.

The dose of the tonic is now increased to 25 drops every three hours ; but on the second morning of the treatment, although all the other symptoms are quite satisfactory, the inflammation is not arrested. 30 drops every three hours are

* Journal of Cases, 1853.

now ordered; and on the following morning, the third of the tonic treatment, the disease has ceased to progress; and on the fourth morning, the patient is rapidly recovering. The tincture is continued for four days longer at the same rate, and then gradually left off. The patient is out of bed on the sixth day of the tonic treatment, when, with the exception of desquamation of the scalp and face, she is free from the effects of the disease; and in point of fact, in better health than previously to its attack. This old lady, in eight days, had administered to her, two ounces of the muriated tincture of iron!

Having studied the effects of this medicine on erysipelatous inflammation for upwards of a quarter of a century, I am enabled to speak with some confidence of its modus medendi; my conviction is, that the success of the practice is to be ascribed mainly, to the powerfully tonic qualities of the muriated tincture of iron, *acting*, as I have said above, *on the sympathetic nervous system*, and through it on the capillary vessels. And I ascribe the calming influence on the heart, which results from the exhibition of this medicine in erysipelas, to a reflex action of the sympathetic on the motor-organic class of nerves.

My theories, however, are of little importance

compared with the fact that the sesqui-chloride of iron acts as a specific in the treatment of this most formidable disease. It has never, in a long course of practice, failed me; and I am very anxious to impress its value on the minds of medical practitioners. I therefore sincerely trust that those Professors, and others, who, finding it inconsistent with their scholastic notions, condemn it untried,—may be induced to give weight, if not to my experiences, yet to the success which has attended the adoption of the practice by others.

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